(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 December 2003 (18.12.2003)

PCT

(10) International Publication Number
WO 03/103864 A1

(51) International Patent Classification[7]: B09B 1/00

(21) International Application Number: PCT/FI03/00459

(22) International Filing Date: 10 June 2003 (10.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20021122 11 June 2002 (11.06.2002) FI

(71) Applicant *(for all designated States except US)*: **GREENVIRONMENT OY** [FI/FI]; Pakkalankuja 7 A, FIN-01510 Vantaa (FI).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **MALKAMÄKI, Matti** [FI/FI]; Purolaakso 3 B, FIN-01680 Vantaa (FI).

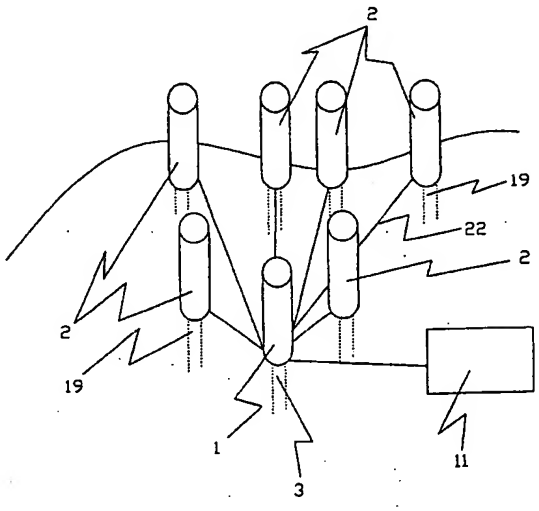
(74) Agent: **KOLSTER OY AB**; Iso Roobertinkatu 23, P.O.Box 148, FIN-00121 Helsinki (FI).

(81) Designated States *(national)*: AE, AG, AL, AM, AT (utility model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (utility model), DE, DK (utility model), DK, DM, DZ, EC, EE (utility model), EE, ES, FI (utility model), FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK (utility model), SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO utility model (GH), ARIPO patent (GH), ARIPO utility model (GM), ARIPO patent (GM), ARIPO utility model (KE), ARIPO patent (KE), ARIPO utility model (LS), ARIPO patent (LS), ARIPO utility model (MW), ARIPO patent (MW), ARIPO utility model (MZ), ARIPO patent (MZ), ARIPO utility model (SD), ARIPO patent (SD), ARIPO utility model (SL), ARIPO patent (SL), ARIPO utility model (SZ), ARIPO patent (SZ), ARIPO utility model (TZ), ARIPO patent (TZ), ARIPO utility model (UG), ARIPO patent (UG), ARIPO utility model (ZM), ARIPO patent (ZM), ARIPO utility model (ZW), ARIPO patent (ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI,

*[Continued on next page]*

(54) Title: METHOD AND SYSTEM FOR REDUCING LANDFILL METHANE EMISSIONS




(57) Abstract: The invention relates to a method and a system for reducing methane emissions of a landfill and for verifying a methane emission reduction. A landfill is provided with a system comprising a burner apparatus (1) for burning landfill gas. The first burner apparatus (1) comprises collecting means for collecting landfill gas, measuring means for measuring and verifying the methane amount of the landfill gas collected by the collecting means, the measuring means comprising a gas analyser (7) for measuring the methane content of the landfill gas collected by the collecting means, and a burner for burning the landfill gas collected by the collecting means. Landfill gas is collected with the collecting means, the methane amount of the landfill gas collected by the collecting means is measured and verified with the measuring means, and landfill gas collected by the collecting means is burnt with the burner apparatus (1).

WO 03/103864 A1

SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Declaration under Rule 4.17:**

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

**Published:**

— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# METHOD AND SYSTEM FOR REDUCING LANDFILL METHANE EMISSIONS

## BACKGROUND OF THE INVENTION

[0001] The invention relates to a method for reducing methane emissions of a landfill and verifying a methane emission reduction.

[0002] The invention also relates to a system for reducing methane emissions and verifying a methane emission reduction.

[0003] In this context, a methane emission reduction refers to a reduction of emissions, which is achieved by burning methane to carbon dioxide and taking the Kyoto Protocol and its annexes into account.

[0004] According to Article 3 of the Kyoto Protocol, the member states of the convention, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases do not exceed their assigned amounts. According to the Protocol, the member states must reduce their overall emissions of greenhouse gases by at least 5 per cent below 1990 levels till 2012. The greatest allowable amount of emissions, i.e. an emission quota, is defined for each member state.

[0005] Article 3 of the above-mentioned Kyoto Protocol refers to the overall amount. Individual emission producers in each member state naturally affect said overall amount. The Kyoto Protocol also contains regulations concerning punishments if a member state does not achieve its goal and exceeds its overall amount, i.e. the emission quota. The Kyoto Protocol also includes regulations on the international emission trading (ET). Emission trading simply means that an emission quota, which is not needed in a member state, can be transferred to another member state.

[0006] It is not simple or inexpensive, however, to reduce greenhouse gas emissions to the level defined in the Kyoto Protocol in practice.

## BRIEF DESCRIPTION OF THE INVENTION

[0007] It is an object of the invention to provide a simple and cost-efficient solution for reducing greenhouse gas emissions in such a place in each member state where the greenhouse gas emissions can be reduced easily so that the released capacity can be transferred to such places either in the same member state or in another member state where greenhouse gases are produced and where it is difficult to reduce them.

[0008] The object of the invention is achieved by a method and a system, which are characterized by what is disclosed in the independent claims.

[0009] The preferred embodiments of the invention are disclosed in the dependent claims.

[0010] According to Item 1 (viii) of Article 2 of the Kyoto Protocol, landfills are within the scope of the Kyoto Convention. This Article refers to limitation and/or reduction of methane emissions of waste management, i.e. landfills.

[0011] Methane ($CH_4$) is a greenhouse gas and in greenhouse gas calculations its conversion coefficient is 21. The conversion coefficient is based on the Kyoto Protocol and its decision 2/CP.3. In the solution of the invention methane is burnt, whereby it turns into carbon dioxide, the conversion coefficient of which is 1 in the greenhouse gas calculations. This means that as one unit of methane emission is converted by burning into one unit of carbon dioxide by using the solution of the invention, 20 units of carbon dioxide, for instance, can be produced in addition to the carbon dioxide obtained by burning methane without increasing the greenhouse gas emissions.

[0012] With the solution of the invention, methane emissions on landfills are reduced by placing a burner apparatus or apparatuses on a landfill, comprising collecting means for collecting landfill gas containing methane and a burner for burning the landfill gas containing methane and collected by the collecting means. The burner apparatus also comprises measuring means for measuring and verifying the amount of methane to be burnt. These measuring means can detect the methane amount on the basis of the total flow and methane content of landfill gases, for instance. The burner apparatus can also comprise calculating means for converting the amount of methane burnt into standard cubic units or the amount burnt in tons. The verified reduction of greenhouse gases, i.e. the amount of methane converted into carbon dioxide by burning, can be transferred under the terms of the above-mentioned Kyoto Convention as an emission reduction, for example, to a place where greenhouse gases are produced and where it is difficult or expensive to reduce their production.

[0013] The method and system of the invention provide the advantage that being simple, the invention does not require great investments

or constructions. It is easy to mount the system of the invention to be operative.

**[0014]** First burner apparatuses of the solution and second burner apparatuses possibly used in the solution can be formed into standard units, which are mounted in a well provided in a landfill and which comprise all equipment necessary for burning methane and measuring the methane to be burnt.

**[0015]** Furthermore, the solution of the invention provides the advantage that the greenhouse gas reduction achieved can be sold in the international emissions market in favour of a third party.

## BRIEF DESCRIPTION OF THE FIGURES

**[0016]** In the following the invention will be described in greater detail in connection with preferred embodiments and with reference to the attached drawings, in which

Figure 1 shows a system for reducing methane emissions of a landfill and verifying a methane emission reduction,

Figure 2 shows a first burner apparatus, and

Figure 3 shows a second burner apparatus.

## DETAILED DESCRIPTION OF THE INVENTION

**[0017]** Figure 1 shows a system for reducing methane emissions of a landfill and verifying a methane emission reduction.

**[0018]** The system comprises at least one first burner apparatus 1 for burning methane-containing landfill gas (not shown).

**[0019]** Figure 1 shows a system which comprises one first burner apparatus 1 and several second burner apparatuses 2, which will be described later. The number of first burner apparatuses 1 and second burner apparatuses 2 can differ from the number shown in Figure 1.

**[0020]** The first burner apparatus 1 shown in Figure 2 comprises first collecting means (not marked with a reference number) for collecting landfill gas. In Figure 2, the first collecting means comprise a first well 3 in a landfill, a first pipe 4 in the first well 3 and a first blower 5, by which landfill gas can be sucked from the first well 3 through the first pipe 4.

**[0021]** The first burner apparatus 1 shown in Figure 2 further comprises a burner (not marked with a reference number) comprising ignition electrodes 6 for burning the landfill gas collected by the first collecting means

and first measuring means (not marked with a reference number) for measuring the methane amount of the landfill gas collected by the first collecting means. It is also possible that the first measuring means are not parts of the first burner apparatus 1 but parts of the system.

**[0022]** Besides methane, other materials can be burnt simultaneously in the first burner apparatus 1.

**[0023]** The first burner apparatus 1 is preferably mounted in immediate proximity to the first well 3 provided in the landfill, more preferably at least partly in the first well 3. The first burner apparatus 1 can be mounted partly in the first well 3 provided in the landfill so that, for instance, the first pipe 4 of the collecting means of the first burner apparatus 1 is located partly in the first well 3, as shown in Figure 2. In Figure 2, the first burner apparatus 1 is placed above the first well 3 and partly in the first well 3, i.e. on top of the first well 3 and partly in the first well 3. The collecting means of the first burner apparatus 1 can also be arranged to collect landfill gas in some other manner.

**[0024]** The system may be such that landfill gas is burnt well-specifically, which means that landfill gas is always led from one first well 3 to only one first burner apparatus 1. Such a system is shown in Figure 1. Alternatively, landfill gas can be led to one first burner apparatus 1 from several first wells 3.

**[0025]** The first measuring means comprise a gas analyser 7 for measuring the methane content of landfill gas. The first measuring means can also comprise a first flow meter 8 for measuring the flow of landfill gas, a first thermometer 9 for measuring the temperature of landfill gas and a first pressure gauge 10 for measuring the pressure of landfill gas. The first measuring means can also comprise a first hygrometer (not shown) for measuring the humidity of landfill gas. The first measuring means can also comprise a first calculating unit 24, to which the measurement results of the gas analyser 7, the first flow meter 8, the first thermometer 9, the first pressure gauge 10 and the first hygrometer can be transmitted and which is arranged to calculate, on the basis of the measurement results, the amount of methane to be burnt in the first burner apparatus 1 as standard cubic units and possibly to convert it by means of an adverse factor into a greenhouse gas. The first calculating unit 24 can be arranged to store the calculated methane amount in a memory or to document the calculated methane amount in some other way.

[0026] The first calculating unit 24 can be arranged to transmit the measurement results to a central processing unit 11.

[0027] It is also possible that the gas analyser 7, the first flow meter 8, the first thermometer 9, the first pressure gauge 10 and the first hygrometer are arranged to transmit the measurement results elsewhere, such as to the central processing unit 11, which is arranged to calculate, on the basis of the measurement results, the amount of methane to be burnt in the first burner apparatus 1 as standard cubic units and possibly to convert it by means of the adverse factor into a greenhouse gas.

[0028] The first calculating units 24 of several first burner apparatuses 1 can be arranged to transmit the measurement results to the same central processing unit 11. If the system comprises second burner apparatuses 2, the second calculating units 12 thereof can also be arranged to transmit the measurement results to this central processing unit 11. These first calculating units 24 and the second calculating units 12 need not necessarily be located on the same landfill, but the information can be transmitted to one central processing unit 11 from different landfills.

[0029] Figure 2 shows the well-specific first burner apparatus 1, the operational principle of which is simplified as follows: the blower 5 sucks landfill gas through the first pipe 4 which is partly in the first well 3 and supplies it to a measuring pipe 13, which comprises the first thermometer 9 and the first pressure gauge 10 and a sampling manifold 14, from which a landfill gas sample is led into the gas analyser 7 to measure the methane content of the landfill gas. After the pressure of the landfill gas has risen above the set limit value in the measuring pipe 13 after the first blower 5, a magnetic valve 15 leading to combustion opens and lets the gas flow through the first flow meter 8 to an orifice pipe 16, through the openings 17 of which the gas is discharged into a premixing pipe 18. In the premixing pipe 18 the landfill gas is mixed with air absorbed from the bottom part of the premixing pipe 18, thus forming a combustible gas mixture, which is ignited by means of the ignition electrodes 6 attached to the outer circumference of the premixing pipe 18, the electrodes forming an electric arc at the level of the upper edge of the premixing pipe 18. After being released from the premixing pipe 18, the methane-containing gas mixture ignites and burns in its entirety while it passes to the upper part of the actual combustion chamber 30, from which the combustion gases are released into the air.

[0030] The system of the invention can comprise a second burner apparatus 2, which comprises second collecting means (not marked with a reference number) for collecting landfill gas.

[0031] The second collecting means of the second burner apparatus 2 shown in Figure 3 comprise a second well 19 in a landfill, a second pipe 20 in the second well 19 and a second blower 21, by which landfill gas can be sucked from the second well 19 through the second pipe 20.

[0032] The second burner apparatus 2 also comprises second measuring means (not marked with a reference number) for measuring and verifying the landfill gas collected by the second collecting means and the methane amount of the landfill gas to be burnt with the second burner apparatus 2. The second measuring means comprise sample leading means 22 for leading a landfill gas sample of the landfill gas collected by the second collecting means from the second burner apparatus 2 to the first burner apparatus 1 in order to measure the methane content of the landfill gas collected by the second collecting means by using the gas analyser 7 included in the first measuring means of the first burner apparatus 1.

[0033] The second burner apparatus 2 can be arranged to transmit a landfill gas sample at regular intervals to the gas analyser 7 of the first burner apparatus.

[0034] The second measuring means can also comprise a second flow meter 25 for measuring the flow of landfill gas, a second thermometer 26 for measuring the temperature of landfill gas, a second pressure gauge 27 and a second hygrometer (not shown) for measuring the pressure of landfill gas.

[0035] The second burner apparatus 2 also comprises a second burner 23 for burning the landfill gas collected by the second collecting means.

[0036] The second burner apparatus 2 is preferably mounted in immediate proximity to the second well 19 provided in the landfill, more preferably at least partly in the second well 19. The second burner apparatus 2 can be mounted partly in the second well 19 provided in the landfill so that the second pipe 20 is located partly in the second well 19. The second burner apparatus 2 can be placed above the second well 19 and partly in the second well 19, i.e. on top of the second well 19 and partly in the second well 19. The second collecting means of the second burner apparatus 2 can also be arranged to collect landfill gas in some other way.

[0037] The system may be such that landfill gas is burnt well-specifically with the second burner apparatuses 2, which means that landfill gas is always led from one second well 19 to only one second burner apparatus 2. Such a system is shown in Figure 1. Alternatively, landfill gas can be led to one second burner apparatus 2 from several second wells 19.

[0038] Besides methane, other materials can be burnt simultaneously in the second burner apparatus 2.

[0039] Since the gas analyser 7 is a relatively expensive component, the costs of the system can be cut down by including such second burner apparatuses 2 in the system that do not comprise a gas analyser 7 but that include sample leading means or other methane content sensors (not shown).

[0040] The measurement results of the second flow meter 25, the second thermometer 26, the second pressure gauge 27 and the second hygrometer can be supplied from the second burner apparatus 2 to the first calculating unit 24 of the first burner apparatus 1, the calculating unit being arranged to calculate, on the basis of the measurement results of the second measuring means of the second burner apparatus 2 and the methane content measured by the second methane content sensor, the amount of methane to be burnt in the second burner apparatus 2 as standard cubic units and possibly to convert this by means of the adverse factor into a greenhouse gas.

[0041] Alternatively, the gas analyser 7 of the first burner apparatus 1 can be arranged to transmit the measurement results concerning the methane content of the landfill gas to be burnt in the second burner apparatus 2 back to the second burner apparatus 2, which comprises the second calculating unit 12 which is arranged to calculate, on the basis of the measured values, the amount of methane to be burnt in the second burner apparatus 2 as standard cubic units and to convert it by means of the adverse factor into a greenhouse gas. The second calculating unit 12 of the second burner apparatus 2 can be arranged to store the calculated greenhouse gas value in the memory or to transmit the greenhouse gas value to the central processing unit 11.

[0042] It is also possible that the gas analyser 7, the second flow meter 25, the second thermometer 25, the second pressure gauge 27 and the second hygrometer are arranged to transmit the measurement results elsewhere, such as to the central processing unit 11, which is arranged to

calculate, on the basis of the measurement results, the amount of methane to be burnt in the second burner apparatus 2 as standard cubic units and possibly to convert it by means of the adverse factor into a greenhouse gas.

**[0043]** The second burner apparatus 2 can have a similar operational principle as the first burner apparatus 1 shown in Figure 2, except that the methane content of the landfill gas is measured in the first burner apparatus 1.

**[0044]** It is possible that materials other than methane are simultaneously burnt in the second burner apparatus 2.

**[0045]** If the system comprises such second burner apparatuses 2, the first burner apparatus 1 can be arranged to control the second burner apparatus 2 so that the first burner apparatus 1 transmits starting and stopping commands to the second burner apparatuses 2.

**[0046]** The invention also relates to a method for reducing methane emissions of a landfill and verifying a methane emission reduction.

**[0047]** In the method, a landfill is provided with a system comprising at least one first burner apparatus 1 for burning landfill gas.

**[0048]** The first burner apparatus 1 comprises first collecting means for collecting landfill gas, first measuring means for measuring and verifying the methane amount of the landfill gas collected by the collecting means, the first measuring means comprising a gas analyser 7, and a first burner for burning the landfill gas collected by the first collecting means.

**[0049]** In the method, landfill gas is collected by the first collecting means and the methane amount of the landfill gas collected by the first collecting means is measured and verified with the first measuring means. Landfill gas collected by the first collecting means is burnt with the first burner apparatus 1.

**[0050]** In addition to the gas analyser 7, the first measuring means can also comprise a first flow meter 8, by which the flow of landfill gas is measured in the first burner apparatus 1, a first thermometer 9, by which the temperature of landfill gas is measured, a first pressure gauge 10, by which the pressure of landfill gas is measured, and a first hygrometer, by which the humidity of landfill gas is measured.

**[0051]** The first measuring means can measure the flow of landfill gas to be supplied to the first burner, which can be used for detecting the amount of landfill gas to be burnt, the humidity of landfill gas to be supplied to

the first burner, the temperature of landfill gas to be supplied to the first burner and the pressure of landfill gas to be supplied to the first burner, and they can measure the methane content of the landfill gas to be supplied to the first burner. These measured values can be supplied to a first calculating unit 24, which calculates, on the basis of these values, the amount of methane to be burnt in the first burner as standard cubic units. Since methane is a greenhouse gas, the greenhouse gas reduction thus achieved with the method of the invention can be transferred to another place by emission trading, for instance.

**[0052]** The first calculating unit 24 can convert the amount of methane burnt in the first burner apparatus 1 by means of the adverse factor into a greenhouse gas.

**[0053]** The first calculating unit 24 can store the information on the amount of methane burnt in the first burner in its memory or it can document this amount in some other way.

**[0054]** The first calculating unit 24 can also transmit the information on the amount of methane burnt in the first burner further to a central processing unit 11. The information on the amount of methane burnt in the second burner apparatus 2, calculated with a second calculating unit 12 included in the second burner apparatus 2, can also be transmitted to the central processing unit 11.

**[0055]** The central processing unit 11 can be located on a landfill or elsewhere. The first calculating units 24 of several first burner apparatuses 1 and the second calculating units 12 of the second burner apparatuses 2 can be arranged to transmit the measurement results to the same central processing unit 11. These first calculating units 24 and the second calculating units 12 need not necessarily be located on the same landfill, but it is possible that the information is transmitted to one central processing unit 11 from different landfills.

**[0056]** In the method, the landfill can be provided with a first well 3 and the first collecting means of the first burner apparatus 1 can be combined with the first well 3 to collect landfill gas. Alternatively, landfill gas can be collected for burning in the first burner apparatus 1 in some other way.

**[0057]** In the method, a number of first wells 3 can be formed.

**[0058]** In the method, the landfill gas can be burnt with the well-specific first burner apparatus 1, which can be placed at least partly in the first

well 3. Alternatively, landfill gas can be led from several first wells 3 to one first burner apparatus 1.

**[0059]** In the method, the landfill can also be provided with at least one second burner apparatus 2, which is simpler than the first burner apparatus 1, because it does not comprise a gas analyser 7. The methane content of the landfill gas to be burnt in such a second burner apparatus 2 is measured in the first burner apparatus 1, which comprises a gas analyser 7, or with a second methane content sensor (not shown).

**[0060]** The second burner apparatus 2 comprises second measuring means for measuring and verifying the methane amount of the landfill gas collected by the second collecting means. The second measuring means comprise second methane content sensors (not shown) or sample leading means 22 for leading a landfill gas sample of the landfill gas collected by the second collecting means from the second burner apparatus 2 to the first burner apparatus 1 in order to measure the methane content of the landfill gas collected by the second collecting means by using the gas analyser 7 included in the first measuring means of the first burner apparatus 1.

**[0061]** The second collecting means collect landfill gas and by using the sample leading means 22, the landfill gas sample is led from the second burner apparatus 2 to the gas analyser 7 of the first measuring means of the first burner apparatus 1. The methane amount of the landfill gas collected by the second collecting means is measured and verified by using the gas analyser 7 of the first measuring means of the first burner apparatus 1 and the second measuring means of the second burner apparatus 2. Landfill gas collected by the second collecting means is burnt with the second burner apparatus 2.

**[0062]** It is obvious to a person skilled in the art that as technology advances, the basic idea of the invention can be implemented in various ways. The invention and the embodiments thereof are thus not restricted to the above examples but may be modified within the scope of the claims.

CLAIMS

1. A method for reducing methane emissions of a landfill and verifying a methane emission reduction, **characterized** by

providing the landfill with a system comprising at least one first burner apparatus (1) for burning landfill gas, the first burner apparatus (1) comprising

first collecting means for collecting landfill gas,

first measuring means for measuring and verifying the methane amount of the landfill gas collected by the first collecting means, the first measuring means comprising a gas analyser (7) for measuring the methane content of the landfill gas collected by the first collecting means, and

a first burner for burning the landfill gas collected by the first collecting means,

collecting landfill gas with the first collecting means,

measuring and verifying the methane amount of the landfill gas collected by the first collecting means with the first measuring means, and

burning landfill gas collected by the first collecting means with the first burner apparatus (1).

2. A method as claimed in claim 1, **characterized** by

forming at least one first well (3) in the landfill, and

leading landfill gas from the first well (3) to at most one first burner apparatus (1).

3. A method as claimed in claim 1, **characterized** by

also providing the landfill with at least one second burner apparatus (2) comprising

second collecting means for collecting landfill gas,

second measuring means for measuring and verifying the methane amount of the landfill gas collected by the second collecting means, the second measuring means comprising sample leading means (22) for leading a landfill gas sample of the landfill gas collected by the second collecting means from the second burner apparatus (2) to the first burner apparatus (1) in order to measure the methane content of the landfill gas collected by the second collecting means by using the gas analyser (7) included in the first measuring means of the first burner apparatus (1), and

a second burner for burning the landfill gas collected by the second collecting means,

collecting landfill gas with the second collecting means,

leading the landfill gas sample with the sample leading means (22) from the second burner apparatus (2) to the gas analyser (7) of the first measuring means of the first burner apparatus (1),

measuring and verifying the methane amount of the landfill gas collected by the second collecting means by using the gas analyser (7) of the first measuring means of the first burner apparatus (1) and the second measuring means of the second burner apparatus (2), and

burning landfill gas collected by the second collecting means with the second burner apparatus (2).

4. A method as claimed in claim 3, **characterized** by

forming at least one second well (19) in the landfill, and

leading landfill gas from the second well (19) to at most one second burner apparatus (2).

5. A method as claimed in any one of claims 1 to 4, **characterized** by transmitting the information on the amount of methane burnt in the system to a central processing unit (11).

6. A system for reducing methane emissions of a landfill and verifying a methane emission reduction, **characterized** in

that the system comprises at least one first burner apparatus (1) for burning landfill gas, comprising

first collecting means for collecting landfill gas,

first measuring means for measuring and verifying the methane amount of the landfill gas collected by the first collecting means, the first measuring means comprising a gas analyser (7) for measuring the methane content of the landfill gas collected by the first collecting means, and

a first burner for burning the landfill gas collected by the first collecting means.

7. A system as claimed in claim 6, **characterized** in

that the landfill is provided with at least one first well (3),

that the first collecting means of the first burner apparatus (1), intended for collecting landfill gas, are connected to at most one first well (3).

8. A system as claimed in claim 6 or 7, **characterized** in

that the system comprises at least one second burner apparatus (2) comprising

second collecting means for collecting landfill gas,

second measuring means for measuring and verifying the methane amount of the landfill gas collected by the second collecting means, the second measuring means comprising sample leading means for leading a landfill gas sample of the landfill gas collected by the second collecting means from the second burner apparatus (2) to the first burner apparatus (1) in order to measure the methane content of the landfill gas collected by the second collecting means by using the gas analyser (7) included in the first measuring means of the first burner apparatus (1), and

a second burner for burning the landfill gas collected by the second collecting means.

9. A system as claimed in claim 8, **characterized** in

that at least one second well (19) is formed in the landfill,

that the second collecting means of the second burner apparatus (2), intended for collecting landfill gas, are connected to at most one second well (19).

10. A system as claimed in any one of claims 6 to 9, **characterized** in that it comprises means for transmitting the information on the amount of methane burnt in the system to a central processing unit (11).

11. A method as claimed in any one of claims 1 to 5, **characterized** by

calculating the verified methane amount of the landfill gas, and

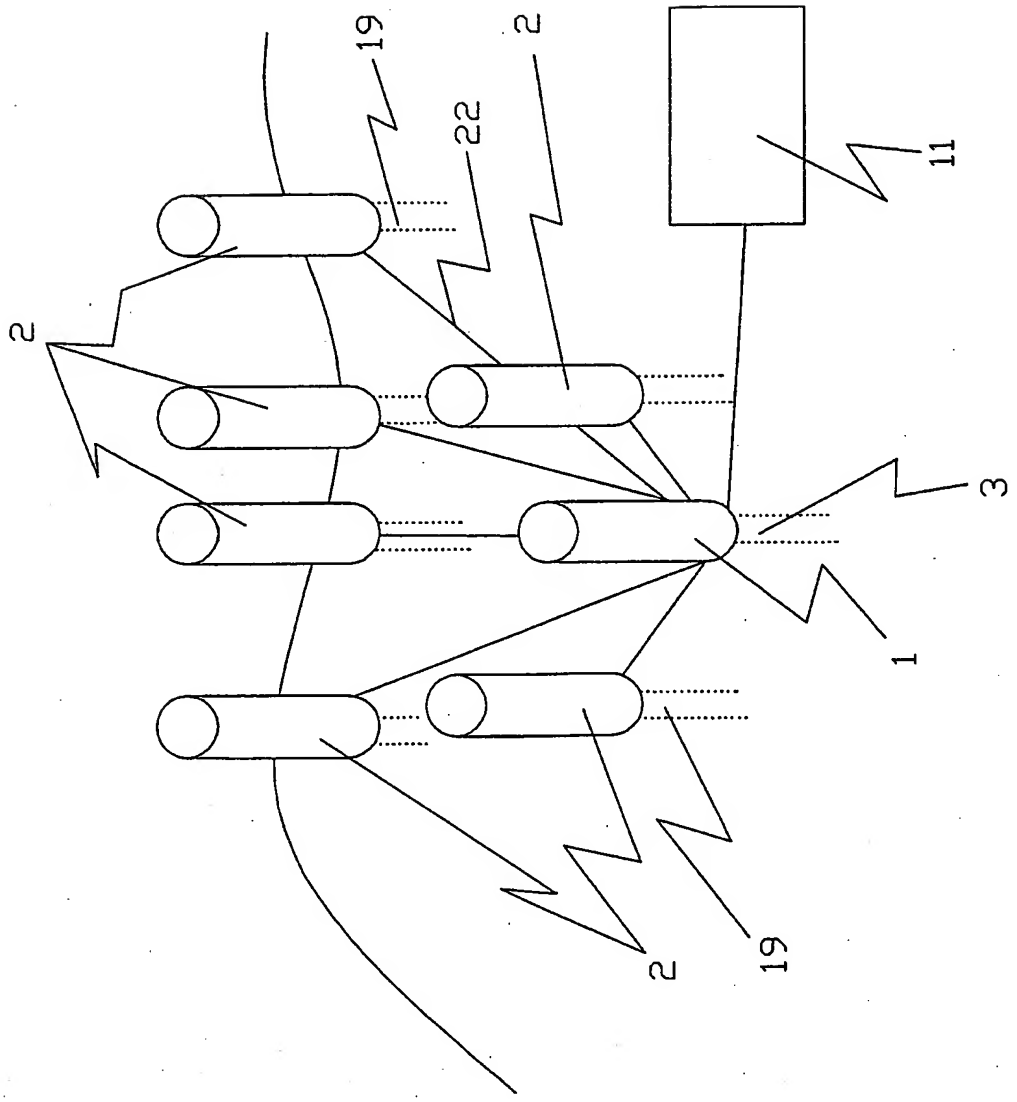
transferring the verified methane amount of the landfill gas within the scope of emission trading (ET) as an emission right to another place.

12. A method as claimed in any one of claims 1 to 5 or 11, **characterized** by calculating, on the basis of the verified methane amount of the landfill gas, the equivalent amount of carbon dioxide by using a conversion coefficient.

13. A method as claimed in claim 12, **characterized** by using a conversion coefficient which is based on the Kyoto Protocol and its decision 2/CP.3.

14. A method as claimed in any one of claims 1 to 5 or 11 to 13, **characterized** by selling the verified methane amount of the landfill gas as an emission right.

FIG 1



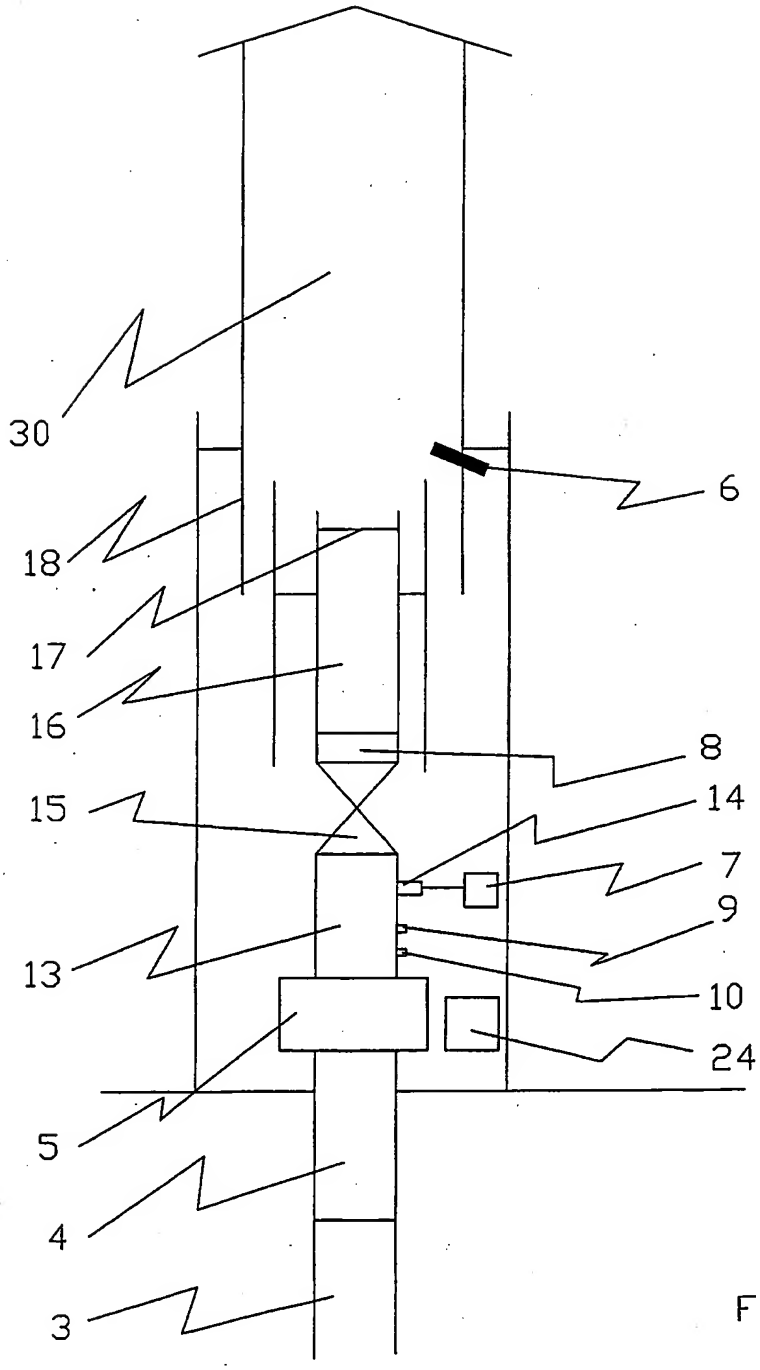



FIG 2

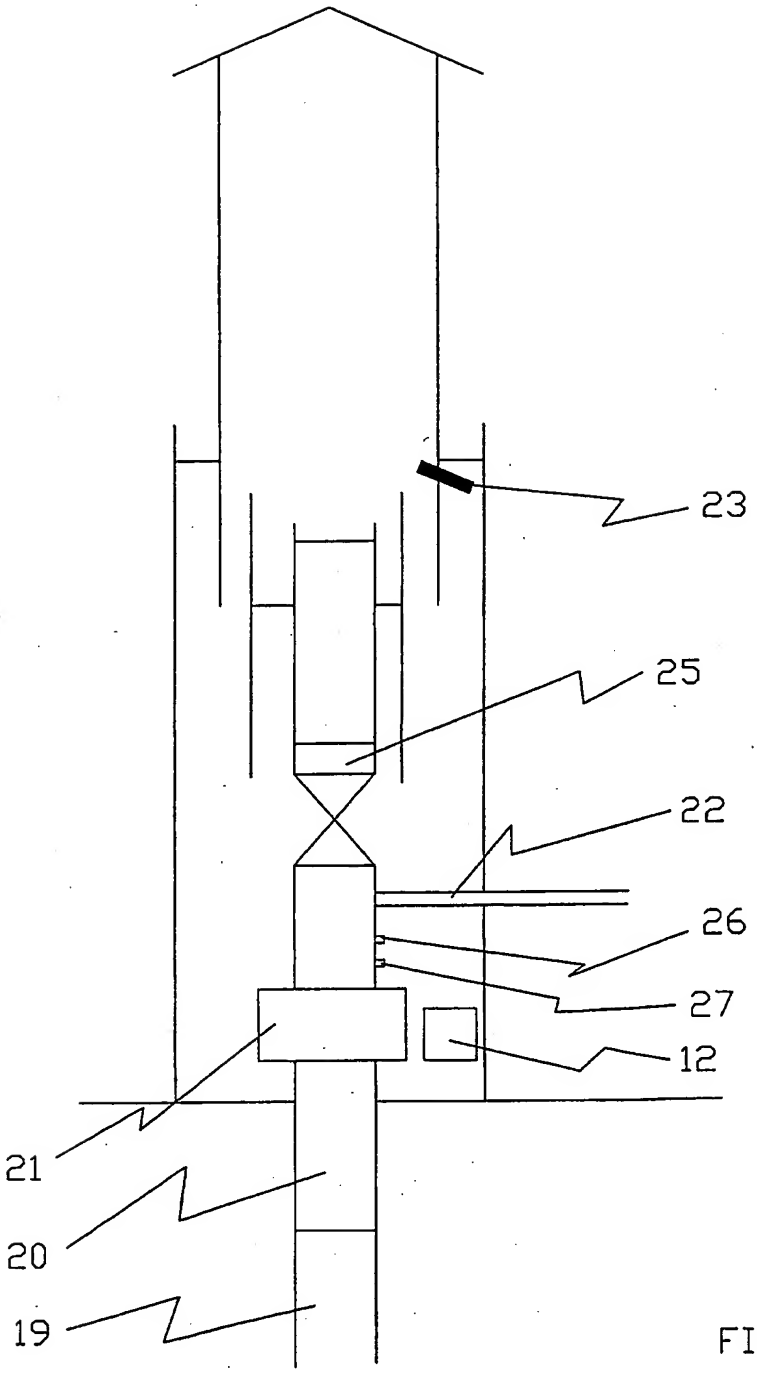



FIG 3

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 03/00459

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B09B 1/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL, PAJ, COMPENDEX, INSPEC, BIOSIS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | Waste Manage Res, Volume 18, No 6, 2000, Ayalon Ofira et al, "Alternative MSW treatment options to reduce global greenhouse gases emissions: The Israeli example", page 538 - page 544, see page 542, column 2, line 3 - line 21 and table 1 and 2 | 1-14 |
| Y | Wall Street Journal/Eastern editin, 26 October 1999, Peter A. McKay, "U.S. landfill concern, Ontario Utility agreed swap gas emission rights", column 2, line 8 - line 17 | 1-14 |
| A | WO 9419120 A1 (HEDESELSKABET ET AL), 1 Sept 1994 (01.09.94), page 1, line 34 - page 2, line 5, abstract | 1-14 |

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 3 Sept 2003 | 05 -09- 2003 |
| Name and mailing address of the ISA/<br>Swedish Patent Office<br>Box 5055, S-102 42 STOCKHOLM<br>Facsimile No. +46 8 666 02 86 | Authorized officer<br>Jens Waltin/ELY<br>Telephone No. +46 8 782 25 00 |

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 03/00459

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 6169962 A (RONALD L. BROOKSHIRE ET AL), 2 January 2001 (02.01.01), column 5, line 20 - line 27; column 5, line 43 - line 65; column 7, line 30 - line 43, column 1, line 60 - line 62, figures 1,2 and abstract<br><br>--<br>-------- | 1-14 |

INTERNATIONAL SEARCH REPORT
Information on patent family members

26/07/03

International application No.
PCT/FI 03/00459

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| WO 9419120 A1 | 01/09/94 | AU 6139594 A | 14/09/94 |
| | | CZ 9502178 A | 17/01/96 |
| | | DK 20693 D | 00/00/00 |
| | | EP 0686069 A | 13/12/95 |
| | | FI 953988 A | 13/09/95 |
| | | HU 9502480 D | 00/00/00 |
| | | NO 953340 A | 23/10/95 |
| | | PL 310405 A | 11/12/95 |
| | | SK 105195 A | 10/01/96 |
| US 6169962 A | 02/01/01 | US 6591695 B | 15/07/03 |
| | | US 2001005812 A | 28/06/01 |
| | | US 5616841 A | 01/04/97 |